泡沫
気泡 Grout Devices
Foaming

CIVIL ENGINEERING, SHIELD BACKFILL GROUTING

TAC CORPORATION

1. Calculation Sample of Foaming

1.	Conditions														
1	TBM O.D													6.15	m
2	Excavation D													6.15	m
3	Segment O.D													6.00	m
4	Segment width													1.20	m/ 1R
5	TBM speed													80	mm/ min
6	Earth pressure	≒ Internal chamber pressure												0.05	MPa
7	Foaming injection ratio													40.0	%
8	Concentration	(Agent) / (Solution)												3	%
9	Expantion ratio	(Foaming) / (Solution)												10 ～ 20	times
10	TBM cross-sectional area	π / 4×	6.15 ^{2}											29.71	m^2
11	Foaming injection volume / 1m	29.71	m^2×1m	×	0.40									11.88	m^3
12	Air injection volume / 1m at 1/20	11.88	m^3/ 1m	×	(19	/	20) × (	0.1	+0.1) /0.1					16.93	Nm^3
13	Air injection volume / 1m at 1/10	11.88	m^3/ 1m	×	(9	/	10) × (	0.1	+0.1) /0.1					16.04	Nm^3
14	Solution volume / 1m at 1/20	11.88	m^3/ 1m	×	(1	/	20)							594	L
15	Solution volume / 1m at 1/10	11.88	m^3/ 1m	×	(1	/	10)							1188	L
16	Foaming injection volume / 1R	11.88	m^3/ 1m	×	1.20	m/ 1R								14.26	m^3
17	Air injection volume / 1R at 1/20	16.93	Nm^3/1m	×	1.20	m/ 1R								20.32	Nm^3
18	Air injection volume / 1R at 1/10	16.04	Nm^3/1m	×	1.20	m/ 1R								19.25	Nm^3
19	Solution volume / 1R at 1/20	594	L/ 1m	×	1.20	m/ 1R								713	L
20	Solution volume / 1R at 1/10	1188	L/ 1m	×	1.20	m/ 1R								1426	L
21	Agent volume / 1R at 1/12	713	L/ 1R	×	3	%								21	L
22	Agent volume / 1R at 1/8	1426	L/ 1R	×	3	%								43	L
23	Foaming injection flow	11.88	m^3/ 1m	×	0.08	m/ min								950	L/ min
24	Air injection flow at 1/20	16.93	Nm^3/1m	×	0.08	m/ min								1354	NL/ min
25	Air injection flow at 1/10	16.04	Nm^3/1m	×	0.08	m/ min								1283	NL/ min
26	Solution injection flow at 1/20	594	L/ 1m	×	0.08	m/ min								47.5	L/ min
27	Solution injection flow at 1/10	1188	L/ 1m	×	0.08	m/ min								95.0	L/ min

2. Models of Foaming

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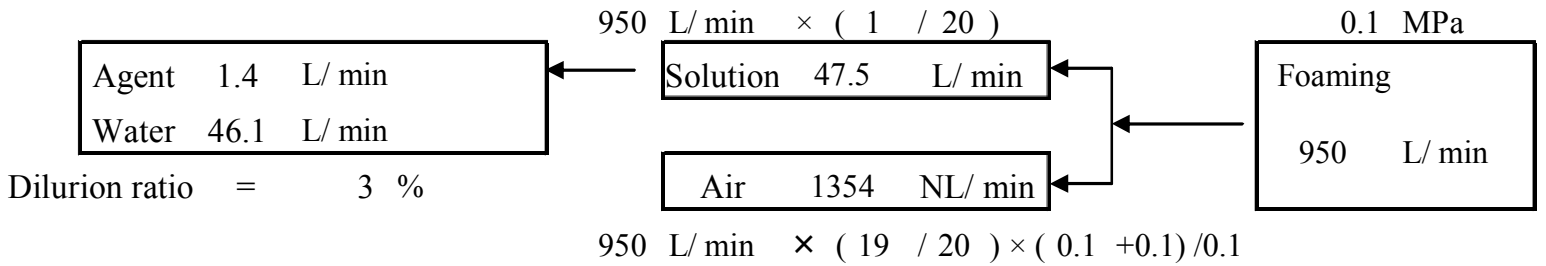
Expansion ratio = 20 times

Jack speed = 80 mm/ min

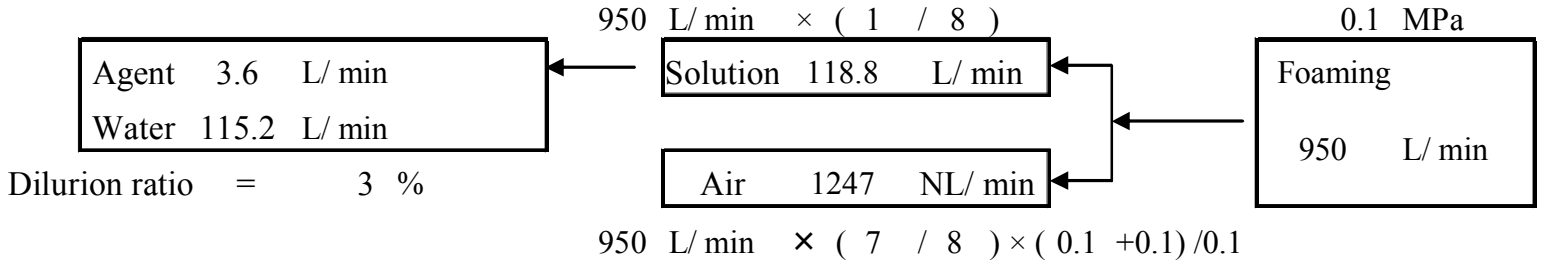


Dilurion ratio = 3 %

950 L/ min × (19 / 20) × (0.1 +0.1) /0.1

Expansion ratio = 8 times

Jack speed = 80 mm/ min



Dilurion ratio = 3 %

950 L/ min × (7 / 8) × (0.1 +0.1) /0.1

3. Specifications of Devices

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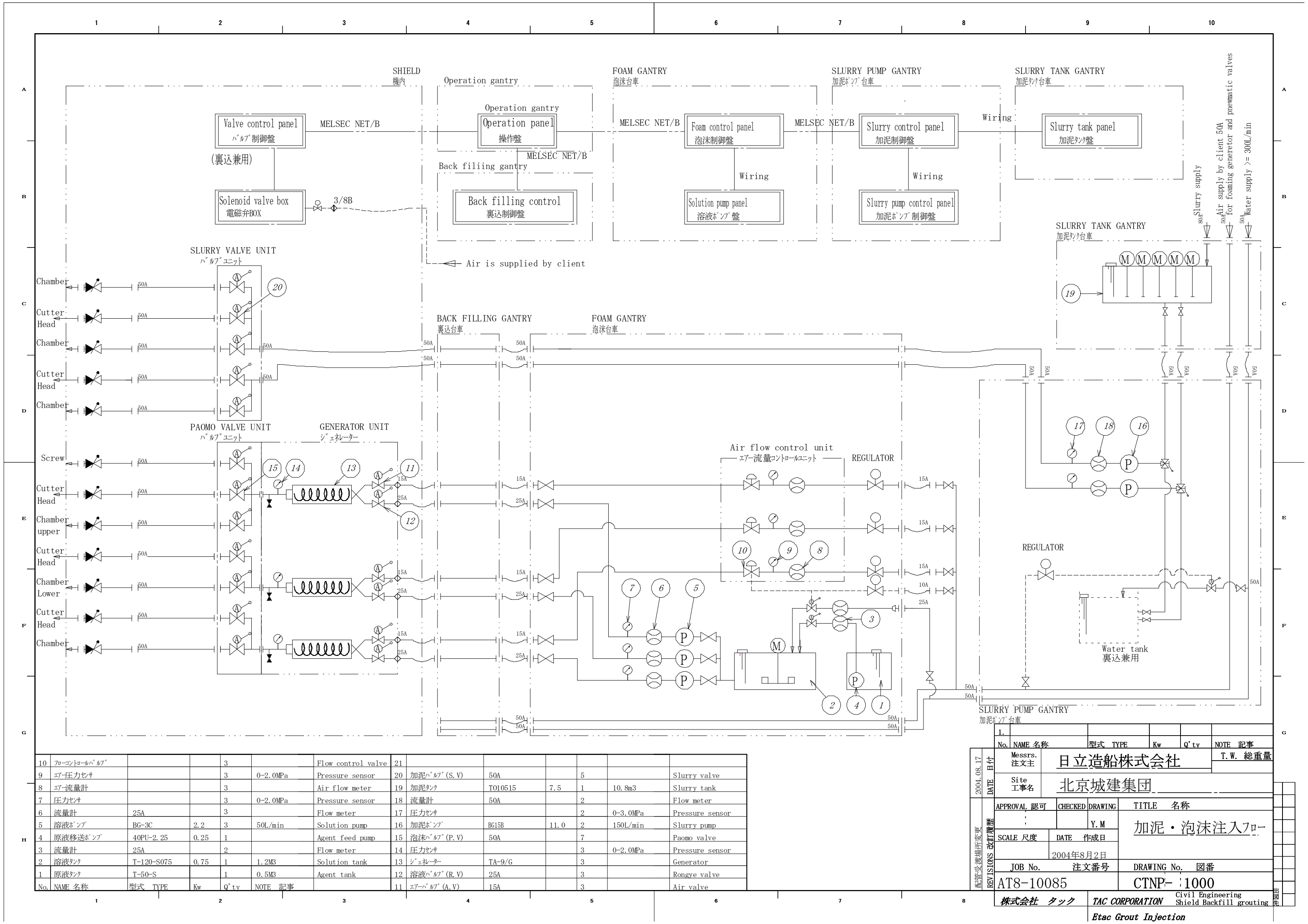
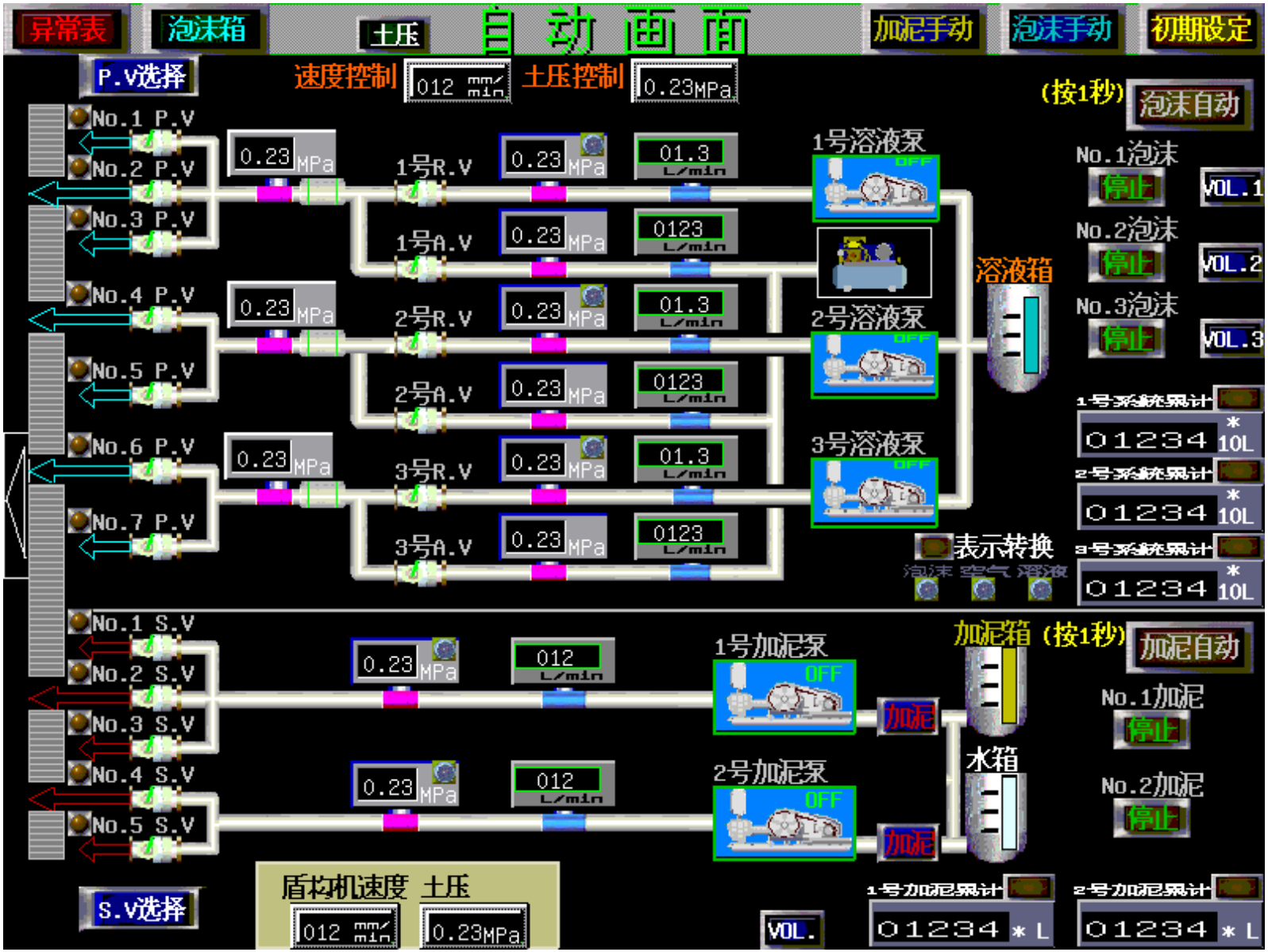
1	Foaming agent tank	0.6m^3	≧ 0.053 m^3/1R×4
2	Foaming solution tank	1.25m^3 + Automatic mixing system	≧ 1.78 m^3/ 1R
3	Foaming agent feed pump	0.25kw	
4	Water feed pump		
5	Foaming pump	Tube type 2.2kw Max1.2MPa 25L/min×3nos.	≧ 118.8 L/min
6	Compressor	equivalent 22kw Max1.00MPa 3.2m^3/min×efficiency0.65×1no.=2.08Nm^3/min	Client ≧ 1.35 Nm^3/ min
7	Flow control valve	3nos.	
8	Air flow meter	3nos.	
9	Flow meter for measure	3nos.	
10	Pressure sensor	Air=3nos. Sol.=3nos. Foaming=3nos.	
11	Generator	3nos.	
12	Foaming control panel		
13	Foaming pump control panel		
14	Valve control panel		
15	Operation panel		

4. Foaming Flow



No.	NAME 名称	型式 TYPE	Kw	Q'ty	NOTE 記事	
10	ﾌﾛｰｺﾝﾄﾛｰﾙﾊﾞﾙﾌﾞ			3		Flow control valve
9	ｴｱｰ圧力ｾﾝｻ			3	0-2.0MPa	Pressure sensor
8	ｴｱｰ流量計			3		Air flow meter
7	圧力ｾﾝｻ			3	0-2.0MPa	Pressure sensor
6	流量計	25A		3		Flow meter
5	溶液ﾎﾟﾝﾌﾟ	BG-3C	2.2	3	50L/min	Solution pump
4	原液移送ﾎﾟﾝﾌﾟ	40PU-2.25	0.25	1		Agent feed pump
3	流量計	25A		2		Flow meter
2	溶液ﾀﾝｸ	T-120-S075	0.75	1	1.2M3	Solution tank
1	原液ﾀﾝｸ	T-50-S		1	0.5M3	Agent tank
21						
20	加泥ﾊﾞﾙﾌﾞ(S.V)	50A		5		Slurry valve
19	加泥ﾀﾝｸ	T010515	7.5	1	10.8m3	Slurry tank
18	流量計	50A		2		Flow meter
17	圧力ｾﾝｻ			2	0-3.0MPa	Pressure sensor
16	加泥ﾎﾟﾝﾌﾟ	BG15B	11.0	2	150L/min	Slurry pump
15	泡沫ﾊﾞﾙﾌﾞ(P.V)	50A		7		Paomo valve
14	圧力ｾﾝｻ			3	0-2.0MPa	Pressure sensor
13	ｼﾞｪﾈﾚｰﾀｰ	TA-9/G		3		Generator
12	溶液ﾊﾞﾙﾌﾞ(R.V)	25A		3		Rongye valve
11	ｴｱｰﾊﾞﾙﾌﾞ(A.V)	15A		3		Air valve

·Foaming Flow （Operation Panel）



5. Foaming Devices

Variety of foaming liquid Pumps

Tube Type

Screw Type

Piston Type

Turbine Type

This type is usually used in Europe.

For separate grout method.

▪ Foaming Devices

Air Flow Control

Foam Generator

Foam Test

Mixing Test (Foam+soil)

6. Control Panel (Parameter Screen)

7. Foam Agent Plant

This system is batch one.

This one is for both Foam and Polymer.